SIXTH ANNUAL REPORT

—OF THE—

NORTH DAKOTA

AGRICULTURAL EXPERIMENT STATION

FARGO, N. D.,

TO THE GOVERNOR.

February 1st, 1896.

JAMESTOWN, N. D.
ALERT, STATE PRINTERS AND BINDERS.
1896.

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STATION STAFF.

J. H. Worst.....Director
E. F. Ladd, B. S.....Chemist
T. D. Hinebauch, M. S., V. S.....Veterinarian
C. B. Waldron, B. S.....Arboriculturist
H. L. Bolley, M. S.....Botanist
J. H. Shepperd, M. S. A.....Agriculturist
E. E. Kaufman, B. Agr.....Dairyman
H. M. Ash.....Farm Foreman
P. W Farnham.....Secretary

FARGO, N. D., February 1st, 1896.

To His Excellency:

ROGER ALLIN,

Governor of the State of North Dakota.

SIR: As required by the act of congress approved March 2nd, 1887, Section 13, Chapter 160 of the Laws of 1890, for North Dakota, I hereby submit the Sixth Annual Report of the North Dakota Agricultural Experiment Station for the year ending February 1st, 1896, together with a financial statement of receipts and disbursements, as required by law, for the government fiscal year ending June 30th, 1895.

Very respectfully yours,

W. H. ROBINSON,

President of the Board of Trustees.

REPORT.

To the Board of Trustees of the North Dakota Agricultural College and Experiment Station:

GENTLEMEN—I have the honor herewith to transmit to you the sixth annual report of the agricultural experiment station.

The reports made by the heads of the different departments contained herein is a brief summary of the past year's work along experimental lines of interest and value to the farmers of the State. Our latitude and climatic conditions have not been overlooked, and particular attention has been given to such experiments as promise practical results.

CHEMICAL DEPARTMENT.

During the past year more work has been done in soil analysis and the material for a bulletin on North Dakota soils is now nearly ready for publication.

Many waters have been analyzed for sanitary purposes, also for irrigation. This line of work is increasing and requires a good portion of time.

At the present time a line of food investigations is in progress, the work being done in connection with the department of agriculture in Washington.

During the past summer experiments were carried on to determine the best methods of conserving soil moisture. The results secured promise a valuable field for investigation, and the work will be continued during the coming year with special reference to mulching and cultivating the surface to various depths.

The work in meteorology has also been continued by this department, and reports made regularly to the Weather Bureau.

Below are given the average per cents of moisture in the soil for each month:

Month.	Surface Soil one to three Inches.				Subsoil Five to Seven Inches.			
	1892.	1893.	1894.	1895.	1892.	1893.	1894.	1895.
May	35.08	31.48	29.15	23.98	35.51	30.21	26.98	24.99
June	29.08	29.63	16.73	22.56	30.22	23.79	19.84	22.43
July	28.39	23.63	16.09	22.97	27.19	26.97	18.58	21.39
August	30.03	21.46	16.42	15.21	30.53	21.57	16.52	16.81
September	28.29	18.88	11.11	26.74	27.94	19.71	11.89	17.32
October	16.53	24.59	28.30	17.44	22.29	24.02	24.78	15.75

The amount of water in the soil at the time of freezing in the fall was less than for any season since the opening of the station at Fargo, but during the growing season the amount averaged more from the better distribution of rainfall during the growing season.

The following table gives the maxima, minima and mean temperature for each month, also the rainfull:

Months.	Maxima.	Minima.	Mean.	Rainfall —Inches.
January	25	—36	—4.4	.36
February	57	—37	.....	.13
March	55	—18	22.1	.00
April	82	18	49.2	1.36
May	91	20	55.0	1.62
June	86	34	61.0	4.81
July	91	39	65.0	3.24
August	92	30.5	.....	1.60
September	90	21	57.6	.00
October	80	—3	39.8	1.00
November	62	15	22.2	1.16
December	42	—18	12.2	.01
Total	.....	.....	.....	14.29

The rainfall for previous years has been in inches:

Amount.	1892.	1893.	1894.	1895.
Total rainfall	21.03	16.16	18.72	14.29

The total rainfall for the year 1895 is considerably less than for either of the three previous years.

BOTANICAL DEPARTMENT.

In this department the work has been continued along lines essentially similar to that of previous years, two phases of work being undertaken, viz: Tests upon growing crops in the field and laboratory investigation along mycological lines. The chief field work is devoted, First—To a study of the wheat plant in its relation to changed soil conditions. Second—The perfecting of practical methods for the prevention of smut in wheat and oats. Third—A study upon the selection of wheat and potatoes for seed purposes.

The work reported upon in our last report concerning bacteriological investigation of milk and dairy products has been continued along certain special lines. This work because of increasing interest in dairying, and the products of the dairy, has yet many phases of interest, and of marked economic value which may well be developed upon closer investigation.

In regard to the two types of work, viz: Field and laboratory investigation, it may be said that it is attempted to carry them out in such manner that they shall give mutually explanatory results. For instance, in an investigation of the subject of the treatment of the different plant diseases: First—Studies are made in the laboratory, as to the actual nature of the cause which brings about a disease. This, if carefully done, furnishes the basis for rational methods of treatment. Previous to an attempt at treatment, numerous tests are made upon the plant to be treated to ascertain exactly the extent to which treatment may be applied, without injury to the normal yield of the crop. This, associated with a further test as to what strength of treatment may be expected to remove the cause, furnished the legitimate basis for field tests. Field tests are made upon two bases, one in which the experiments are sufficiently limited to allow of the most accurate methods of observation as to growth, culture and result on the products, etc., and, Second, upon a scale large enough to arrive at methods applicable to the most extensive type of farming.

Wheat smut has thus been under investigation for the past three years. The results obtained during the past growing season were very promising, and will be reported in a future bulletin.

PUBLICATIONS: Since the last report three regular bulletins have been published by this department, Bulletin No. 17, containing two articles: "The Effect of Seed Exchange Upon the Culture of Wheat"; and "Distribution of Weed Seeds by Winter Winds." The first article shows by experiments that the constant exchange of seed wheat, is not only unnecessary, but may occasion much loss to the farmer. The second article demonstrates that weed seeds, such as Russian thistle and our worst types, are very generally carried over the surface of the ground by the heavy winter winds. Bulletin No. 19 containing a resume of latest methods of treatment of smut in wheat, and the improved method of treating potatoes for the prevention of the disease known as scab. Reports have been received from farmers of the State upon the use of corrosive sublimate treatment for the past year, and are even more encouraging than for previous years; several reports having been received in which potatoes for a very large acreage were treated with success. Mr. Edward Ruthruff of Fargo, reporting the treatment of one thousand bushels, stating that the work could all be accomplished in a day, thus demonstrating the slight cost connected with the work.

Attention is here called to the fact that these desired results are attained upon the soils of this region, which are markedly alkaline, more so perhaps, than an economic application of lime might be expected to occasion upon a soil, distinctly acid. (See Bul. No. 33, Rhode Island Station.)

Bulletin No. 21, under the heading: "Cleanliness in the Handling of Milk, Bacteriological Considerations." The basis for

this publication are the results obtained from investigations conducted upon the bacterial flora of normal milk and in relation to various phases of dairy work. These investigations have been reported upon more fully as to detail of special features in two papers under the following headings: "Cheese Curd Inflation—Its Relation to Bacterial Flora of Fore-Milk," and "Ueber die Konstanz von Backterienarten in Normaler Roh (fore) Milch" in Centralblatt fur Bakteriologic und Parasitenkunde, II Abteilung, I Band, 1895, No. 22-23.

VETERINARY DEPARTMENT.

The present year has been devoted to a further investigation of the effects of feeding millet to horses. In the last experiment a correct analysis was made of the urine by Mr. Robert Reed, a senior student of the college. One of the animals experimented upon was destroyed and a histological examination made of the kidneys, which resulted in finding them diseased to a considerable extent. They presented the following changes: They were in a state of sub-acute Catarrhal Mephritis. There was also a slight granulation of the epithelium, cloudy swelling, which is a forerunner to the more grave degenerative process and leads most frequently to fatty degeneration.

The coming year our investigation will be extended to the effect of millet upon dairy stock when used exclusively as an article of coarse food.

The increase in the number of inquiries from stock owners show that there is a growing demand for the information which is at their disposal.

HORTICULTURAL DEPARTMENT.

The work of the Horticultural department for the season of 1895 included cultural experiments in the line of vegetable gardening, and also the repair and maintenance of the college lawns, drives, trees and shrubbery.

Under the head of vegetable gardening an experiment was undertaken to determine the practicability of using horses in the cultivation of unions grown in rows one foot apart, every seventh row being omitted. The implement used was the "Z Breed Weeder." While considerable gain was made by this method during the fore part of the season, hand labor was necessary during the latter part.

Experiments were also conducted to determine the relative value of onion seeds from the different parts of the United States

and Europe. Further experiments will be necessary before any general conclusions can be drawn. Several different methods of blanching and handling celery were tested. This work will be continued on a larger scale in the future, and in connection with irrigation.

A trial was made to test the value of different insecticides to prevent insect injury to cauliflower and cabbage.

Observations upon an aster disease previously observed at the station, showed that certain strains of European asters are free from this disease.

So far as the funds permitted, the grounds were improved by the extension of walks and drives, and by the planting and care of trees, some of the latter work being partially experimental in its nature.

AGRICULTURAL DEPARTMENT.

Crop experiments have received most attention during the past year. Testing varieties and methods of culture has been the line followed.

Wheat has been tested in variety tests in continuance of experiments carried on for the years previous. The better varieties have been selected for testing and a few new ones have been added to the list. A test of different crops preparatory to wheat has been made and some excellent results have been reached. Wheat following corn, spring rye, rape, millet, flax, summer fallow, etc., have been compared with plots cropped to wheat continuously. The selection of individual plants of wheat has also been carried forward and a record of their performance noted. Crossing and hybridizing has also been studied in a limited way.

Oats have been tested to determine best varieties and careful notes made of the degree to which rust affected the different kinds, as well as the number of days required for maturing, the height of straw and yield of grain, all of which facts will appear in a crop bulletin soon to be published.

Barley has been tested in a way similar to that noted for oats in the previous section.

Flax has been studied in a more extended way than during any previous year. The effect of different preceding crops on the field which included tests of flax following flax, flax following corn, flax following buckwheat, flax following millet, and flax following wheat.

Millet has been studied chiefly from the standpoint of varieties. Indian corn has been given especial attention during the past year. New varieties have been added to the list grown in the variety test, and very careful notes made of the stage of maturity at frost, and of the days required to fully mature, when

ripe at frost, habit of growth, yield of grain and fodder per acre. A study of the manner of seeding corn for fodder was also tested by sowing thick in a wheat drill, thinner in drills further apart, and so on until the ordinary manner of planting in checks both ways with the planter was reached.

A careful selection of the best individual plants was also made in preparation for a line of cross fertilization, or breeding experiments with corn. Careful selection to improve varieties and to obtain kinds which will be suited to the conditions which we have in the State was given much attention.

Potatoes have been grown in variety tests, and the results noted in very careful detail.

Methods of seeding grass have been given very careful study. Timothy and clover have been seeded in many ways, including broadcasting followed by the harrow, seeding in drills at depths increasing by half-inch gradations from half an inch to four and one-half inches deep.

A test of different nurse crops for grass was made, among which are wheat, oats, barley, flax and spring rye. Breeding and selection of timothy plants have also been carried forward.

A number of the less common forage plants have been studied in small nursery plots to determine their value before sowing more extensively.

Dwarf Essex rape has been grown and its yield of green forage carefully noted. The thirty-five rotation plots, the most of which were established some years ago, have been continued and the yields carefully noted.

A bulletin giving the results of the above tests is now in preparation and will soon be published.

HORSE FEEDING.

A study of rough feeds and of grain rations for horses has been made, and the results published in bulletin No. 20 of this station.

Oat straw compared with prairie hay gave the following results:

The horses and mules were kept up in flesh nearly as well when given straw as they were when fed a hay ration when doing light work. More grain was required by the straw fed lots, but with ruling values for the feeds used, shows a saving of more than $1.50 per month per head in the keep of the animals.

Oats compared with bran and shorts, mixed equal parts by weight for horse feed shows little difference in the way of keeping the animals in good flesh.

The test indicates that with oats worth fifteen cents a bushel, bran and shorts would be worth $9.40 per ton, and with oats worth twenty-five cents, bran and shorts mixed, equal parts by weight, would be worth $15.60 per ton.

Wheat as a feed for horses when fed alone and in combination with bran and shorts was also studied. It was found to be too concentrated a grain food to be given alone to horses, and it required great care to keep the animals from getting "off their feed" during the four weeks of the trial. Wheat, (whole) bran and shorts mixed equal parts by weight according to the results of the test made, gave no better results than a mixture of bran and shorts equal parts by weight. This would indicate that when bran and shorts sell for $10 per ton—one-half cent per pound—whole wheat is worth thirty cents a bushel as feed for horses, when mixed as stated.

A grain ration of oats compared with a ration consisting of a mixture of two parts of ground wheat, and one part of bran by weight is worth a little more pound for pound than oats of good quality.

DAIRY DEPARTMENT.

The dairy remained a part of the Agricultural Department until August, 1895, when, by resolution of the Board of Trustees, the Dairy Department was created, and E. E. Kaufman was transferred from the agricultural department and elected dairyman.

This department is now equipped with a first-class creamery and cheese factory for experimental work. No work of that nature has so far been undertaken, as a sufficient milk supply could not be procured during the winter months to insure the completion of such work.

The study of rations for milch cows and the performance of the station herd, consisting of common cows and low grades, was continued during the year 1895, and served to strengthen the points mentioned in the fifth annual report, viz: First. Dairying with the cows which are found on the farms of North Dakota can be made profitable. Second. That excellent cows for butter production can be found among the native and low grade cows of the State. Third. That some of the native and low grade cows can not be kept at a profit, giving too little butter to pay for the food consumed. Fourth. That it pays to feed well on account of so large a portion of the food eaten being required for maintenance.

This department is indebted for favors to the following firms:

Cornish, Curtis & Greene Manufacturing Company for one 20-gallon Boyd cream ripening vat and fermenting can.

Genesee Salt Company, for one 224-pound sack cheese salt.

Porter Bidwell, for privilege of using Bidwell cow stall.

F. B. Fargo & Co., for one gallon Fargo's Butter Color.

FARMERS' INSTITUTES

have been held in a few localities, but without the interest and attention they deserve. While almost all other professions or branches of industry arrange to collect and summarize the best experience and the practical observations of their progressive members for the benefit of the profession or industry, agriculture stands out alone as the world's greatest industry with the least co-operation among its members and the feeblest effort to place it upon a scientific basis. It can scarcely be called a profession. Neither study, preparation or qualification have hitherto been supposed to enter into the question when the choice of this particular occupation was decided upon. It was not supposed that either was necessary.

Today the tendency is toward agriculture as a profession, and agricultural colleges are largely responsible for this change of sentiment. The farmers' institute is an important medium for exchange of views and discussions of methods where the experience and observations of a whole community of farmers during a year can be exchanged in a single day,and each farmer practically benefitted to the extent of all their experimental knowledge.

The heads of the several departments of the Experimental Station have been invited in many instances to address farmers' institutes upon selected topics, and have responded whenever possible. The numerous operations involved in agriculture, stock raising, dairying, etc., are generally discussed at these gatherings, and the tendency is toward more successful methods of farming, and to eliminate as far as possible the element of failure.

The next legislative assembly will doubtless appropriate a sum of money sufficient to give proper encouragement to farmers institutes, and thus help to professionalize and develope the one great possibility of the State.

WEEDS

of various kinds and degrees of annoyance are scattered throughout the farming districts, notably the Russian cactus, French weed, the several varieties of the mustard family, etc., etc. Many samples were sent here last season for classification and for information relative to their nature and best methods for their destruction, or to resist their further progress. This subject is of great importance to farmers and will receive due attention by the proper department of the station.

INVESTIGATION OF FOODS.

Under authority of the United States Department of Agriculture, Prof. Ladd has undertaken (1) a chemical study of wheat, together with the flour and bread products made from the highest grades of wheat, for the purpose of determining the amount of nitrogenous matter, the gluten and gluten constituents. Also the digestibility of these products and of the breads made therefrom. (2) A similar line of investigation with immature and frosted wheats and the flour made therefrom. (3) An investigation of the wheats with the flours and breads therefrom of crops that are more or less smutted, inasmuch as the loss is estimated at from two to three million dollars for the present year in smut alone.

THE EXPERIMENT STATION

was organized in the interests of the farmers of the State, and desires to keep in touch with them. It desires to contribute in every legitimate way toward lifting our agriculture to a higher plane of excellence, and all questions pertaining to the subject will receive candid consideration, and results of experiments on private account are solicited.

January 30, 1896. Respectfully submitted,

J. H. WORST, Director.

GOVERNMENT AGRICULTURAL EXPERIMENT STATION

FOR NORTH DAKOTA

In Account With the United States Appropriation, 1894-5.

Debtor.

To receipts from the treasurer of the United States as per appropriation for fiscal year ending June 30th, 1895, as per Act of Congress approved March 2d, 1887		$15,000 00

Creditor.

By salaries	$5,999 92	
By labor	5,417 67	
By publications	534 60	
By postage and stationery	208 76	
By freight and express	213 73	
By heat, light and water	1,006 85	
By Chemical supplies	7 60	
By Seeds, plants and sundry supplies	349 59	
By feeding stuffs	379 32	
By traveling expenses	414 53	
By contingent expenses	77 07	
By building and repairs	390 36	
		$15,000 00

State Appropriation, 1894-5.

Debtor.

To receipts for year ending June 30th, 1895		$ 350 61

Creditor.

By publications	$ 196 00	
By heat, light and water	90 91	
By tools, implements and machinery	37 45	
By contingent expenses	26 25	
		$ 350 61

The above statement is a correct account of government and State appropriations for the fiscal year ending June 30th, 1895.

P. W. FARNHAM, Secretary.